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Hgiene of Respiration  
& Atmosphere

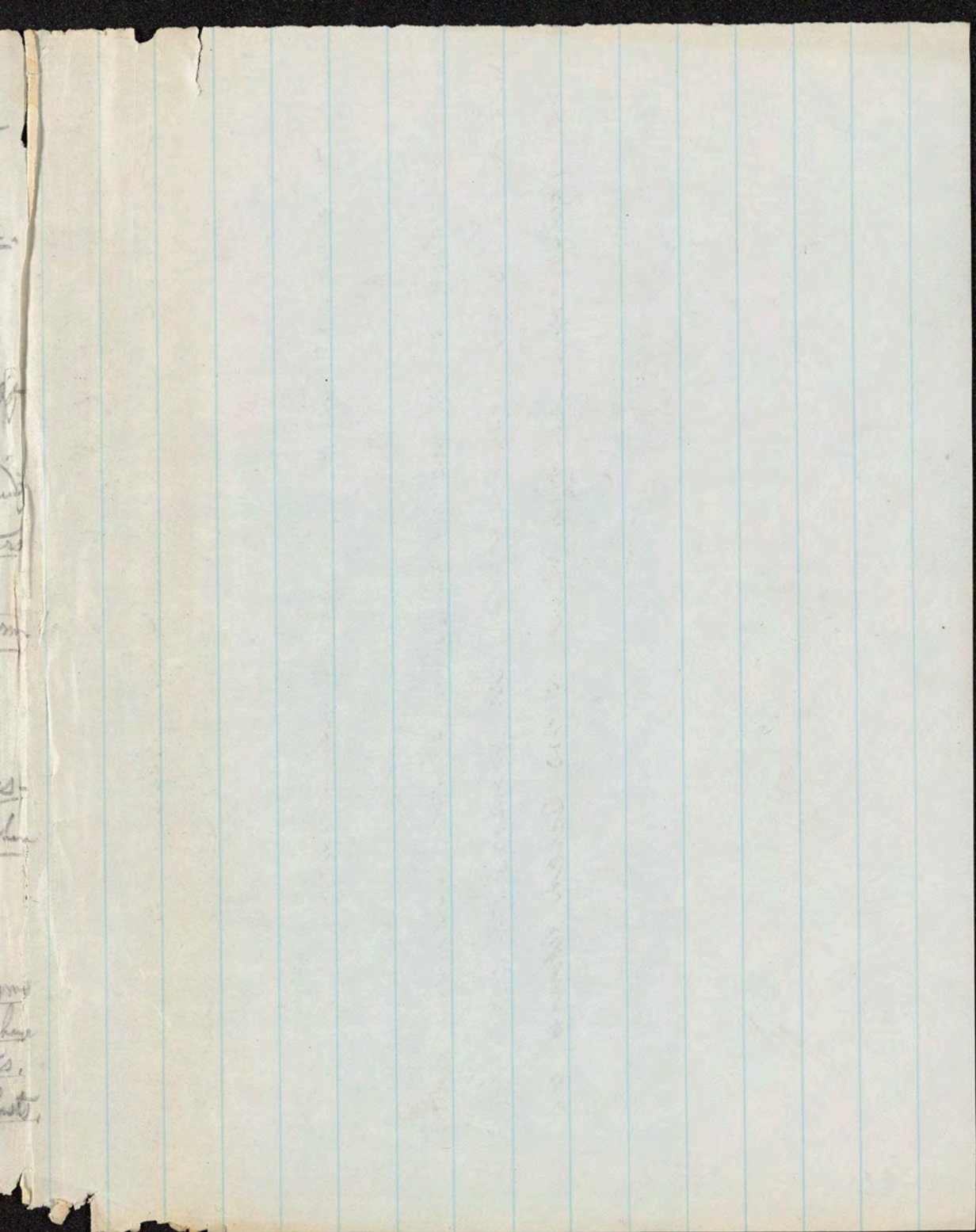


1876, begin with Respiration  
lecture corresponds in length with  
~~XI~~ Lecture of 1866.  
on Board, Subdiv. of Hygiene.

2<sup>nd</sup> Lecture,  
on Board, Excess of CO<sub>2</sub> in air  
Modes of estim. atmosph. humidity  
Weight of air, vapor & sat. air.  
Method of exact determ. of rel. humidity  
Shewed - merc. & aneroid barometers  
Hygrometer -  
wet & dry bulb therm.

3<sup>rd</sup> Lecture,  
on Board,  
Constant, variable & non-ess.  
essential constt. of atmosphere  
Theories of transmission of  
contagious diseases:

Liebig's - exhal. & exhal.  
Snow's - contin. molec. change  
Pacheco's - sepsis  
Pasteur's - disease germs.  
Bowditch's - transpl. bioplasts.





CONDITIONS  
OF  
HEALTHY  
RESPIRATION

## Lecture XII (continued)

### Conditions of Healthy Respiration.

1. Sound Lungs & air-tubes.
2. Muscular Power.
3. Nerve Force
4. Pure Air
5. Renewal of Air.

CONTENTS OF  
THE ATMOSPHERE

### Contents of the Atmosphere

constants

variables

non-essentials

Oxygen. 20.8 ~~varies~~ 20.01

Nitrogen. 79.2 ~~same to~~ 79.95

Carbonic Acid. .04

Watery Vapor. about 1.40

Ozone. - variable -

Iodine. Nitric Acid. Ammonia

Carburetted Hydrogen.

Sulphuretted Hydrogen.

Phosphuretted Hydrogen.

Sulphurous Acid. & Sulphuric acid

Organic Vaporous matter -

Organic Forms.

Mineral Particles -

(1874, after 10 Lectures on Etiology & Public Hygiene,  
entered on Hygiene of Respiration at end of  
10th Lecture.)



These necessities are shared with all the higher animals around us.  
 The whale can remain under water an hour; the  
 Seal a quarter of an hour; a few aquatic birds  
 several minutes; most birds and mammals a minute or  
 two only. Pearl divers seldom <sup>now</sup> continue submerged quite  
 a minute; sometimes I believe they have accomplished a  
 minute and a half. Strange stories are told, with  
 positiveness and an air of authority, of some of the  
 sailors of India. I, for one, cannot believe them.  
 Carpenter admits their possibility. E.g.;

[Leave a space equal to this]

- Robert J. Connell



RESPIRATION  
&  
THE ATMOSPHERE

that of  
Leaving digestion, Our present  
subject to consider is, respiration  
& the atmosphere. Breathing is the  
first necessity of life. <sup>a few breaths... or at least minutes</sup>  
<sup>Cessation of breathing, & we die</sup>

NECESSARY  
CONDITIONS

It is necessary to have good  
lungs, air tubes, muscular power,  
nerve force, pure air, and renew-  
al of air. Examples of defective  
things are so numerous as <sup>scarcely</sup> not  
to need mention. Consumption - Pneumonia - Croup - Asthma

LOSS  
OF  
MUSCULAR  
POWER

An example of the loss of  
muscular power is <sup>at the mouth of death</sup> sometimes seen  
in illness. A person rises from bed  
and after walking a few steps  
is suddenly exhausted. This is  
especially the case if he have  
partial disease of the lungs.

NERVE  
FORCE

Failure of nerve force is seen  
in death by chloroform, <sup>Sumach</sup> or lightning.

EFFECT  
OF HABIT

Muscular power, nerve force  
& even the condition of the lungs  
are affected by habit. <sup>functional exercise</sup> Variation of  
the blood may or may not have  
this effect. <sup>the</sup> amount of blood sent to the lungs must.



Dr<sup>H.B.</sup> Davis of N. York advises fatiguing gymnastics especially with the arms (up) in phthisis!

[space of 6 lines]

[space of 4 lines]

End of 13<sup>th</sup> Lecture, 1870

Case of Dr. J. W. Davis, senior - 1858 - 1873 -  
 Case of Dr. Geo. Dock - 1873 -



PULMONARY  
EXERCISE.GENERAL  
EXERCISE.

Scobigny

gradually

VOCAL  
GYMNASTICS.PURE  
AIR

Dr. Jos. Parrish

In families disposed to phthisis, pulmonary exercise should be taken from early life.

There are two ways <sup>for this</sup> 1st. by general exercise. The synergy is complete. That there is a constant harmony. If we exercise the legs we must exercise the breathing apparatus. In the <sup>high</sup> table lands of S. America the men have long chests, an extra development. This proves that it is possible to expand the chest Dr. H. D. Davis idea.

2nd. Vocal gymnastics: singing and speaking. We must remember that where it is not a pre-disposition, but actual consumption, this course would be injurious. Nevertheless it is good for consumptives to be in the open air as much as they can; oftenest with passive exercise. The necessity of pure air, is obvious to all.

The <sup>elements</sup> content of the atmosphere,



+  
 ^ Leaves of plants will not act  
 upon undiluted carbonic acid; but other  
 gas besides O. & N. will dilute it so  
 as to allow the leaf decomposition of the gas.  
 (Qu. Jour. of Sci. 1866 or 7). Light necessary.  
 [End of 2<sup>nd</sup> Lecture, 1871] ~~Sum~~ \*  
 — Trees near houses — in a city, wholesome.

1/2 part 100  
 100  
 80  
 70  
 \* Leave here a space of 12 lines

Dr Angus Smith M.P. of 5 per cent. better open country. Oxygen & Carbonic acid



~~Atmosphere of 20.61, 79.39~~  
to 20.61 ~~atmosphere of 20.61 to 79.39~~

CONTENTS  
OF  
THE ATMOSPHERE.

are: oxygen 20.8 pts.; nitrogen 79.2  
(considered as a diluent); vapor  
of water, essential to animal life;  
carbonic acid (do. to vegetables). &c.

SAME COMPOSITION  
EVERYWHERE.

It has <sup>almost exactly</sup> the same composition  
everywhere owing to winds, the  
action of plants, and to the law  
of the diffusion of gases.

DALTON

Dalton, Moir, Balguy and  
Lavoisier found a difference of oxygen

and  
less  
an  
the  
from  
salt  
in  
country  
with

in a large hall, there were 10  
times as much CO<sub>2</sub> as should be.

HAMMOND

Dr Hammond states that in a room  
with no ventilation there is twice  
as much as should be.

Lavoisier, 10 times normal amount in wood of Salpêtrière.







~~Still 87.5 to 20.61, 77.95~~  
to 20.61 ~~to 77.95~~

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of the diffusion of gases.

DALTON

MORRIS

LOUIS

CLEMENS

Dalton, Morren, Balguy and  
Lewy found a difference of oxygen  
at different places. Morren found  
more at the sea coast, & Lewy, less  
out at sea. Clemens found an  
excess over lakes, in the stratum of air near the surface.

CO<sub>2</sub>

Carbonic acid is about from  
4 to 6 parts in 10,000. Boussingault  
& Lewy found small differences in  
different places. <sup>out of door</sup> 15 parts in 10,000. H. L. Paris & country.  
<sup>Baron de Luna says instead.</sup>

DALTON

HAMMOND

Dr. Dalton of New York found that  
in a large hall, there were 5 to 10  
times as much CO<sub>2</sub> as should be.  
Dr. Hammond states that in a room  
with no ventilation there is twice  
as much as should be.

L. Blanc, 10 times normal amount in wind of Salpêtrière.



End of 13<sup>th</sup> Lecture, 1868.

From last page

Coal-period;

(space for this,  
as directed on  
last page)

Aquarium; &

trees in cities, - plants in a house,

or room; beneficial: except while in bloom.





WE CANNOT  
BREATHE  
PURE  $\text{CO}_2$

Pure carbonic acid cannot be breathed; not even 40 pr. ct.; yet we are always exhaling it.

When breathed, a gradual anesthesia results. delute, animals

REGNAULT.

Regnauld asserts that we can bear 23 pr. ct. of  $\text{CO}_2$  if they have twice as much oxygen. Pigeons; my exp. - space, 8 hrs.

HAMMOND

Hammond says a bird can live in 45 oxygen, 30 nitrogen, & 25 carbonic acid.

BARKER.

Dr. Barker <sup>found</sup> that no excess of oxygen will prevent the fatal effects of carbonic acid, if retained in the blood. If injected into the veins of dogs, they will live if they have oxygen <sup>supplied</sup>, but if their head be tied, they will die <sup>in a day</sup>.

$\text{CO}_2$  A  
NEGATIVE POISON.

CARBONIC  
OXIDE

Carbonic acid is called a negative poison; it clogs the operations of life. ~~It~~ <sup>By some</sup> accounted to be positively Carbonic oxide is more decidedly poisonous; but late experiments render this doubtful. Instances of death from want



[End of 16<sup>th</sup> Lecture, 1873.]

A gentleman present at the time of the occurrence  
 \* J. Thompson mentioned to me an incident ~~with~~  
 in Glasgow, 1858, in theatre, panic about fire:  
 180 or 200 men <sup>about</sup> rushed down a stairway into a small  
 room whose folding doors opened inward, fell together  
 against these, clog them, & about 80 men suffocated  
 to death. — 100 or 120 taken out alive, about  
 $\left\{ \frac{2}{3} \text{ suffocated} \right\}$



BLACK HOLE OF CALCUTTA

STEAMER LONDONDERRY

ALGERINE WAR.

of renewal of air, are familiar. That of the Black Hole of Calcutta is the most famous. 146 men were put into a room 18 feet square, having two small windows. All but 23 died.

The steamer Londonderry <sup>Some years since</sup> was overtaken by a storm <sup>down</sup> and the captain fastened the hatches to prevent water getting in. Seventy-two died <sup>before they were lighted.</sup>

During the Algerine war, a general caught a band of the natives in a cave; ~~so~~ setting a fire at the mouth of it he suffocated them. <sup>Gen. Polissier</sup>

Space 10 lines

Avondale 1870 - 200 suffer by fire at night  
& Pittston, 1871, 30 - 500, fire in shops & stores

SUFFOCATION FROM  
The feature of the southern list was a fir feeling in new South Carolinas, which left at 2 1/2 a 1/2. The rest of the list was steady.  
The railway and miscellaneous list was during the morning, with prices alternate weak and strong. During the afternoon the general market stiffened up 1/4 a 1/2 per cent. Wabash, Ohio, and Boston, Hartford and Erie being the leading features.  
Street quotations at 5 1/2 P. M.  
N. Y. C. & Hudson consolidated, 92 1/2 a 92  
N. Y. C. & Hudson certificates, 87 1/2 a 87  
Harlem, 121 a 122 1/2; Erie, 30 1/2 a 30 1/2; Reading, 113 1/2 a 113 1/2; Lake Shore, 88 a 88 1/2; Scrip, 81 1/2 a 81 1/2; Wabash, 61 1/2 a 61 1/2; Pittsburgh, 127 1/2 a 127 1/2; Northwestern, 60 1/2 a 60 1/2; do. pref., 90 1/2 a 90 1/2; Milwaukee & St. Paul, 55 a 55 1/2; do. do. pref., 77 1/2 a 78; Ohio at Ft. Wayne, 91 a 91 1/2; New Jersey 108 1/2 a 108 1/2; Mississippi, 43 1/2 a 43 1/2; W. U. Telegraph Union Pacific, 43 1/2 a 43 1/2; Pacific Mail, 47 1/2 a 47 1/2; Adair Express, 85 a 85 1/2; Wells, Fargo & Co. Express, 51 a 60; Amer. Mer. Union Express, 51 1/2 a 51 1/2; U. S. Express, 58 1/2 a 58 1/2; Michigan Central, 116 a 118; Illinois Central, 130 1/2 a -; Mariposa 1 a 1 1/2; do. pref., 1 1/2 a 2.  
New York, Nov. 23. - Cotton quiet a steady at 18 1/2 a 18 1/2 c. Flour dull and favorable. Whisky, 24c. Wheat unsettled, 8

ation from carbonic acid from human breath, different. In exhaling, matter is thrown out. Tightened rooms have an at smell on entering. aris, suicide is committed charcoal fire. There is



[End of 16<sup>th</sup> Lecture, 1873.]

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 to death. — 100 or 120 taken out alive about  
 {  $\frac{2}{3}$  suffocated }

ATMOSPHERIC AIR.—The English "Health of Towns Commission," which has made careful experiments upon the air breathed by large masses of people, reports that the atmosphere of great manufacturing cities is less deleterious than the air of unventilated rooms inhabited by human beings. Thus, in the city of Manchester the factory chimneys throw out daily two thousand tons of carbonic acid gas, and yet the air is not seriously contaminated. The greatest enemy to man is his own breath, as has been proved by a table prepared by the "Health Commission." The number of parts of carbonic acid in ten thousand parts of air taken from different places are given as follows: Pure atmospheric air, 4; streets of great cities, 6; stables, 7; pit of Comic Opera House in Paris, 15; ceiling of Comic Opera House, 28; asylum, 17; hospital, 30; dormitory at night, 52; bedroom on rising in morning, 48; bedroom after two hours' ventilation, 16; railway carriage, 31; workshop, 19; lecture hall, 32; and a well-filled school-room, 72.



BLACK HOLE OF CALCUTTA

STEAMER LONDON DERRY

ALGERINE WAR.

SUFFOCATION FROM CO<sub>2</sub> FROM HUMAN BREATH

SUICIDE IN PARIS.

of renewal of air, are familiar. That of the Black Hole of Calcutta is the most famous. 146 men were put into a room 18 feet square, having two small windows. All but 23, died.

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During the Algerine war, Gen. Polissier caught a band of the natives in a cave; ~~so~~ setting a fire at the mouth of it he suffocated them.

Suffocation from carbonic acid and that from human breath, are quite different. In exhaling, organic matter is thrown out. Badly-ventilated rooms have an unpleasant smell on entering.

More of this topic <sup>presently</sup>. In Paris, suicide is committed by a charcoal fire. There is

Space 10 lines

Arundale 1870 - 200 suffocated by fire in mine  
& Putnam, 1871, 30 - 600, fire in shaft, mine





1871/4?

Promotion of  
Society  
with 8000

End of 14th Lecture, 1867.

13. 1869

\* In 1871, a young man from the country, in one of the ~~Western~~ cities,  
 ^ on going to bed in his room at a hotel, blew out the gas. He was  
 waked up by unpleasant feelings — got up & lit his gas; was sick  
 at stomach, vomited, felt a little better, blew out his gas and  
 again lay down. After that he lay still till somebody broke  
 into his room to find him almost dead.



**FOR GENTLEMEN,  
NO. 33 SOUTH SIXTH STREET.**

**Fine Boots and Shoes for Gentlemen.**

**HELWEG & FUNK**

Invite the attention of gentlemen to their large stock of FALL and WINTER first quality **BOOTS and SHOES**, ready-made on improved last, which ensure comfort, beauty and durability. Gentlemen leaving their measures may depend on every attention being paid to their orders, and goods can be forwarded to any part of the world.

**HELWEG & FUNK,**

No. 614 ARCH STREET,  
Directly Opposite the Theatre.  
The Patent American Gaiter may be had here.  
oc20 m w s 3mrps

**AT MORRELL'S, 923 PINE ST.,**  
you will find a splendid assortment of first-class **BOOTS and SHOES** for **LADIES, MISSES and CHILDREN**, all of which are hand-sewed and made to order at short notice.  
set-6mrps

**SEWING MACHINES.**

**PRICES REDUCED.**

Two students of the  
One of them, after Dr.  
were suffocated by a  
fire. Dr. Jackson  
ed them, by means of  
en. A clergyman almost  
life in the same manner.  
se cases there was no

It is remarkable that  $CO_2$  has not yet been success-  
fully used as an anesthetic in surgery? Some at least of  
On the other hand, those who

were in the Black-Hole, died sud-  
denly. Some had convulsions. Several  
retained consciousness to the last.

Burning gas contains <sup>a little</sup> carbonic  
acid, ~~free hydrogen~~, carbonic oxide, ammonia, ~~and~~  $H_2S$ ,  
carburetted hydrogen, sulphur-  
etted hydrogen, <sup>sulphuretted hydrogen</sup>, bisulphide of carbon,  
sulphurous acid.

It may be fatal; but its strong  
smell <sup>the product usually</sup> gives warning. Instances  
have happened, as in leakage of  
gas pipes. A gentleman from Cuba in New York, 1866.

True carbonic acid suffocation  
is the most likely to happen. A  
landlord who wanted to get rid of  
a tenant stopped up the chimney

VIOLENCE  
OF DEATH IN  
THE  
BLACK-HOLE

BURNING-GAS.

$CO_2$   
SUFFOCATION.





### Seventy Children Rendered Insensible by Coal-Gas in a School-Room.

SUSQUEHANNA DEPOT, Pa., Dec. 12.—Seventy children attending school at Oakland, a little village near here, had a narrow escape from suffocation from coal gas on Tuesday morning. The presence of the poison in the air was not known to the teacher until about eleven o'clock, when the smaller children began to drop from their seats to the floor, where they lay unconscious. The teacher then, greatly alarmed, announced the dismissal of the school, but not over half the scholars could get out of their seats, and the remainder rapidly fell into unconsciousness. As quickly as possible they were dragged into the air and laid on the ground. A few of them revived on getting into the air, but twenty-five remained unconscious. A physician was summoned, who succeeded, after long and persistent efforts, in reviving all of them. One little girl was three hours insensible. If they had remained in the school-room but very little longer half of them at least would have been past all relief. Several are yet very sick from the effects of the gas. The foul air was driven into the room by the stove-pipe having by some means been jammed against the back of the chimney, preventing draught.

1874?

Prevention of  
Cruelty Society,  
with dogs

End of 14<sup>th</sup> Lecture, 1867.

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\* In 1871, a young man from the country, in one of the Western cities, on going to bed in his room at a hotel, blew out the gas. He was waked up by unpleasant feelings — got up & lit his gas; was sick at stomach, vomited, felt a little better, blew out his gas and again lay down. After that he lay still till somebody broke into his room to find him almost dead.



CASES OF  
DR. MORGAN,  
AND  
OF A CLERGYMAN.

VIOLENCE  
OF DEATH IN  
THE  
BLACK HOLE

BURNING-GAS.

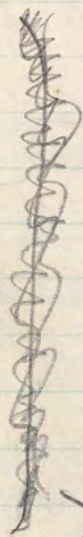
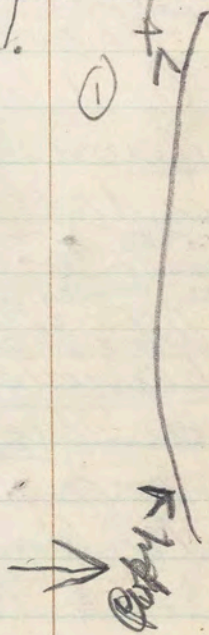
CO<sub>2</sub> SUFFOCATION.

no pain. Two students of the University (one of them, ~~afterwards~~ Dr. Morgan) were suffocated by a charcoal fire. Dr. Jackson ~~was~~ resuscitated them, by means of pure oxygen. A clergyman <sup>whom I attended</sup> almost lost his life in the same manner. In all these cases there was no suffering. ~~It is remarkable that CO<sub>2</sub> has not yet been successfully used as an anesthetic in surgery. Some at least of~~ On the other hand, those who were in the Black-Hole, died suddenly. Some had convulsions. Several retained consciousness to the last. Burning gas contains <sup>a little</sup> carbonic acid, ~~free hydrogen~~ carbonic oxide, ammonia, ~~or H<sub>2</sub>S~~, sulphuretted hydrogen, <sup>sulphuretted hydrogen</sup> bisulphide of carbon, sulphurous acid. It may be fatal; but its strong smell, <sup>which is produced usually</sup> ~~which~~ gives warning. Instances have happened, as in leakage of gas pipes. A gentleman from Cuba in New York, 1866, True carbonic acid suffocation is the most likely to happen. A landlord who wanted to get rid of a tenant stopped up the chimney

X



See "Nature", <sup>vol</sup> ~~vol~~ 1872, for  
~~Richardson's experiments~~ <sup>experiments</sup> ~~(or Tyndall's)~~ with  
 a respirator in carbolic atmosphere; designed  
 for miners. Very efficient but fatiguing to  
use.



(2)  
 Tyndall's  
 Respirator

[Space of a page]



old deep wells - & brewers' vats. ←

so that the fire could not be supplied with ~~drain~~. It was, and consequently the family was killed.

In Laves' Physiology of Common

EFFECTS OF IMPURE AIR ON TWO DIFFERENT BIRDS.

Life of a few hours meantime did degenerate

EFFECTS ON TWO GIRLS.

girl to ch with

CAUSE.

Do not live 4 weeks without food (1875) in an ice house.

ROOMS WANTED AND TO RENT.

TO RENT - TO A SMALL, RESPECTABLE family, in exchange for board, the dwelling part of a desirable up-town drug store, near Fifth and 11th street and Second and Third street cars. Address B. M. P., Ledger Office.

TWO FRONT ROOMS TO RENT. APPLY AT 1741 Crosby street, above Ridge and Columbia avenues. \*50

TO LET - DWELLING PART OF HOUSE. bath, hot and cold water, 1232 S. Second st. 21\*28

TWO FURNISHED ROOMS IN SECOND story, 1013 Oxford street. \*157

ROOMS TO LET, S. E. CORNER MARSHALL and Poplar. Entrance on Marshall, No. 863. \*4

TO LET - ROOMS, WITH AND WITHOUT power, N. W. corner Twelfth and Filbert streets, No. 1338 Chesnut street. 21\*25

TO RENT - TWO OR THREE ROOMS, ON SECOND floor, 1200 Deacon street, first house above yard avenue. \*27

TO LET - FOR MANUFACTURING PURPOSES, the Second, Third and Fourth Floors of building North Sixth street. 31\*173

FURNISHED ROOMS FOR SINGLE GENTS AT \$1 per week. 147 N. Thirtieth street. \*15

TWO ROOMS TO RENT FOR STORAGE OF to a single, respectable person, in a family of 11, at address 49 North Thirty-eighth st., West Philadelphia. \*211

WANTED - TWO GENTLEMEN LODGERS IN a private family, 1333 Brandywine st. 31\*199

TO RENT - SECOND, THIRD AND FOURTH story rooms of 1108 Market street; have been used Boys' School for the last twenty-eight years, 20x 20 ft rooms. 31\*183

TO LET - A PLEASANT FURNISHED ROOM for lodging to a single gentleman. No. 823 Vine st. 31\*179

ROOMS TO RENT, 1620 PINE STREET. \*208

TO LET - A FINE ROOM, THIRD FLOOR, front, 707 Sansom street. \*191

TO LET - A FURNISHED ROOM, 926 FILBERT street. \*229

TO RENT - A FURNISHED ROOM FOR MAN and Wife, 422 North Fourth street. \*233

TO LET - TWO SECOND-STORY ROOMS, NO. 1221 Davis street. \*330

TWO ROOMS TO RENT, UNFURNISHED, 709 Bayard street, below Wharton. \*203

TO RENT - TWO FURNISHED OR UNFURNISHED front Rooms in a very desirable central location. Address F. O. S., Ledger Office. 21\*216

FURNISHED ROOMS FOR A RESPECTABLE gentleman and wife; also for single gents, \$1 per week, 1013 Morgan st., between Race and Vine. \*426

UNFURNISHED ROOM FOR GENTLEMAN IN private family, at 706 Pine street. \*537

TO RENT - TWO PLEASANT ROOMS, NEWLY papered and painted. Inquire 1707 Thompson. \*549

ROOMS TO RENT, N. E. CORNER OF THIRTEENTH and Master streets. 21\*520

TO LET - FURNISHED ROOMS, 614 SOUTH Washington Square and 247 South Sixth st. \*690

ROOMS

permanently mentioned placed in an it will live for a bird be affected, it (no. 2) will itself has by itself to the

and a feeble occasional a room with the healthy one in good health, the oxygen is greater It is greatest animals see the in a bird it in a reptile &c. above station of the change of temper air.



See "Nature", early in 1872, for  
~~Richardson's experiments~~ <sup>experiments</sup> ~~of~~ <sup>Hendall's</sup> with  
 a respiration apparatus; designed  
 for mine use.

**INSURE AIR.**—"Air and Rain, the Beginning of a Chemical Climatology," is the title of a book just published in London. The author is Dr. Robert Angus Smith, who essays to throw new light upon the origin of diseases. He gives in an elaborate series of tables some valuable information regarding the state of air in mines. It is found that even in the worst mines the amount of oxygen does not go below 18 per cent., while sometimes the excess of carbonic acid more than makes up for the deficiency of oxygen, the reason being, as Dr. Smith remarks, that when gunpowder is exploded carbonic acid is generated without oxygen being consumed.

In connection with an inquiry for the Mines Commission, Dr. Smith made numerous experiments on the air of confined places, as he modestly says, but in reality he shut himself up sometimes for more than two hours at a time in a small bedchamber, the cubic contents of which were about 170 feet. The following is the record of one of his experiments in this chamber:

"After the experiments on the combustion of candles we entered with candles and a spirit lamp. The lights were soon extinguished, and it was found impossible to rekindle them with matches; wooden matches were used, they refused to ignite. Still we breathed without difficulty at first, but a gradual feeling of discomfort appeared of a kind which is not easily described; it was restlessness and anxiety without pain, while the breathing increased in rapidity. Afterwards gas was ignited, and it burned with brilliancy. On entering after the gas had gone out, candles were extinguished as rapidly and completely as if they had been thrust into water; nevertheless we still breathed, and although every one was anxious to go out, no very correct description of the feelings could be given. I stood on a chair, and then a feeling of incipient fainting began, but the senses were not annoyed by anything beyond a feeling of closeness, by no means so unpleasant as a schoolroom or close end." By means of this chamber Dr. Smith made many valuable experiments of the effect of carbonic acid upon the lungs, and he concludes as follows:

"The fact that men and animals die very rapidly from inhaling pure carbonic acid, while they live comparatively much longer in nitrogen or hydrogen gases, is explained by this: That in an atmosphere of carbonic acid the blood cannot give off any portion of that gas, but, on the contrary, absorbs more of it, by which the small proportion of oxygen in venous blood is expelled from the blood, and consequently its vital functions are much impeded, nay, arrested. When the inspired air has the same composition as that which is exhaled, the object of respiration is no longer attained. The venous blood is no longer changed into arterial, difficulty of breathing, and finally suffocation come on, just as if the mouth and nose had been closed."

The effect of carbonic acid in the air is to make the pulse fall and increase the number of inspirations.

Richardson's experiments

(2) Hendall's Respiration

[Space of a page]

Copy



old deep wells - & brewers' vats. ←

so that the fire could not be supplied with ~~drainage~~ <sup>drainage</sup>. It was <sup>lit</sup> and consequently the family were killed.

EFFECTS OF IMPURE AIR ON TWO DIFFERENT BIRDS.

a few  
meantime

In Lewis' Physiology of Common Life, a curious ~~experiment~~ <sup>experiment</sup> mentioned. If a bird be placed in an air-tight jar, it will live for hours. If another bird be afterwards introduced, it (no. 2) will die <sup>first</sup>. The <sup>first</sup> bird <sup>first put in</sup> has by degrees adapted itself to the change of air.

EFFECTS ON TWO GIRLS.

When a healthy and a feeble girl ~~were~~ <sup>on one occasion</sup> left in a room with a charcoal fire, the healthy one ~~will~~ <sup>good</sup> suffer most. In <sup>good</sup> health, the consumption of oxygen is greater than in ill health. It is greatest in the <sup>most active</sup> highest animals <sup>best</sup> <sup>best</sup> condition. Thus in a bird it is quicker than in a reptile &c. This will explain the above.

CAUSE.

Dog lived 4 weeks without food (1875) in an icehouse.

There is an adaptation of the system to the change of ~~temp~~ <sup>temp</sup> air.



7  
7

ESTIMATION OF  
HUMIDITY  
OF THE AIR.

For Estimation of the Humidity of  
the air:—

Daniell's Hygrometer. (2 bulbs, connected,  
Dry and Wet Bulbs. lower cont. g. ether  
& thermometer, to be  
wet with ether)

Hair Hygrometer (Saussure's).

Weighting.

Barometer.

WEIGHT  
OF AIR  
AND VAPOR.

Weight of 1 cubic foot of dry air  
at 60° Fahr. ————— 536.28 grs.

Weight of 1 cub. foot. vapor — 577. grs.

Weight of 1 cub. foot of air  
saturated with moisture — 532.84 grs.

Pressure of the air, by Barometer.

Dr. Cornelius Black in  
London, England, Oct. 18, 1842.  
with just published observations  
on the humidity of the atmosphere  
middle of the year 1842.



Dr. Cornelius Black, on deficient aeration of blood as promoting disease of right side of heart, & fatty degeneration after middle life.

17.

The excretions are increased.

This goes on more rapidly when time is allowed for adaptation.

It is certain that they who live in bad air do not <sup>always</sup> suffer the injury to be anticipated.

Judges in courts, for example.

Lecture XIII } Cholera (1866.)  
Lecture XIV }

Lecture XV.

The next constituent which we will consider, is watery vapor.

It is by no means nonessential. A certain amount is indispensable. This is proved by the hot winds of Africa, which, deprived of all moisture, are often fatal to life.

Opposed to dryness, is great dampness. In connection with cold, it is very injurious.

The determination of the amount of moisture belongs to meteorology. This is a science of great complexity, and as yet quite immature. — Loomis

EXCRETION INCREASED.

Less oxid.  
of C with CO<sub>2</sub>  
allows making  
more for, C, H, O.

WATERY VAPOR.

ITS NECESSITY.

SIMOONS.

DAMPNESS.



Dont copy

End of 1<sup>st</sup> Lecture 1872.

The moisture in the air <sup>maybe</sup> determined by

The Barometer;

Actual weighing;

Dew-point (Daniell's Bulb Hygrometer);

Sausseur's Hair Hygrometer;

Dry & Wet Bulbs (Mason's);

Hygrodeik (Edson's);



[After this; 'Facts at first']

19

At Philadelphia, the  
 highest barometrical pressure is, daily,  
 at about 9 A.M.; the other maximum  
 between 9 & 10 in the evening; the two  
 minima, at about 4 in the morning &  
 4 in the afternoon. The monthly  
 averages of barometrical pressure are  
 in most places <sup>(except on the coast of Asia)</sup> about the same  
 throughout the year; although the amount  
 of vapor, with us, is quite different,  
 being greatest in July & least in  
 January; 4 times as much in July  
 as in January. The extreme fluctua-  
 tions of the barometer seldom exceed 3 inches.  
 At Boston they are between  $31\frac{1}{8}$  &  $28\frac{1}{2}$  inches.  
 At London 3 inches of range; in Iceland &  
 St. Petersburg  $3\frac{1}{2}$ ; at one place near the Equa-  
 tor, less than half an inch for years together.  
 As to variations of humidity, the dew point in  
 ordinary pleasant weather here is  $10^{\circ}$  to  $15^{\circ}$  below  
 the temperature of the air. At sometimes, however, is  $30^{\circ}$   
 or  $40^{\circ}$  below it. In India, sometimes  $61^{\circ}$  below it; <sup>in parts of California</sup>  $78^{\circ}$ .

the moisture necessary for its saturation.

air, has  
temperature  
al ways

in dry  
expansion  
ometer  
the pres-  
& Hygrosco-  
py.

$0^{\circ}$  weighs  
air sat-  
84 grs.,  
+  $52^{\circ}$  by 42 grs.  
at  $77^{\circ}$ , 9.8 grs.

t will  
[Baromet-]  
hygrom-  
tempera-  
begin  
cooled.

will be  
Mexico,

by cool-  
rometer.



5) The explanation of these (B)  
 "gaseous pressure" changes is,  
 the heating of the earth by the sun  
 and the air ~~by~~ the earth;  
 the warmed air thus expanding  
 into a higher column, which then  
runs off from the top to the lower  
 atmosphere around it; making a  
 lighter column, because expanded,  
 & so tending to lessen the air pressure  
 on the barometer. But, as these two  
 sorts of pressure, — that of vapor  
 and that of the gaseous atmosphere,  
 are differently affected by the sun's  
 influence through the day, the barom-  
 etric diurnal variations are <sup>determined</sup> ~~affected~~  
 by the composition of the two together; &  
 thus there are two daily maxima and  
 two daily minima of the barometer, different  
 at different places, in time as well as in degree.

The moisture

The



The most constant causes

of variation in the pressure of the air as shown by the barometer are, changes in the amount of vapor, and changes in the temperature and height of the gaseous atmosphere.

Every day both of these change somewhat regularly, at least when the sky is clear. <sup>Foot Philadelphia.</sup> The vapor in the air is least an hour before sunrise. As the sun ascends, he raises, by his heat, moisture from the surface of the earth, ~~shown~~ by a lowering of the barometer all day, till a little before sunset. Then, with the cooling of the earth and air, the vapor descends and leaves the air. The gaseous atmospheric pressure varies according to another law. It is greatest about an hour after sunrise, and diminishes till about 4 P. M. in this vicinity; then it increases again till morning.

air, has temperature al ways

in dry expansion. ometer the pres-

& HygroscoPy.

0° weighs of air sat-

84 grs., at 52° by 42 grs. foot; at 77°, 9.8 grs.

It will

[Barom]

ells hygrom

tempera-

ill begin

ly cooled.

re will be

N. Mexico,

by cool-

grometer.



For example:

Suppose the temperature of the air, as shown by the dry bulb, to be  $53^{\circ}\text{F}$ .  
~~On the tables show that at~~ and the wet bulb thermometer to mark  $50^{\circ}$ ; difference,  $3^{\circ}$ ; — which is the "dryness observed".  
 By the table in use, it is shown that at the temperature of  $53^{\circ}$  the difference between the dry and wet bulbs is  $\frac{1}{2}$  the difference between the temperature of the air and the dew point. So we multiply  $3^{\circ}$ , the diff. of bulbs, by 2, — and then subtract this product,  $6^{\circ}$ , from the dry-bulb temperature,  $53^{\circ}$ ; — and we get  $47^{\circ}$  for the dew point. Now, another table shows that, for this dew point, the vapor pressure is  $.288$  of an inch <sup>equal to the exert of</sup> high column of mercury; while, at  $53^{\circ}$  dew point, it would be equal to  $.403$  of an inch. These numbers,  $.288$  &  $.403$  are to each other about as 72 to 100. The relative humidity of the air then, in the case considered, is 72.

— Hygrodeik —

The moisture

The

At

D

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4



The easiest thing to obtain first is  
the difference between the temperature of the  
wet and dry bulbs.

Tables <sup>in use which have been</sup> are then prepared from  
observation and calculation, showing  
the proportion between this difference  
(or the observed dryness) and the  
difference between the <sup>the air (dry bulb)</sup> ~~observed~~ temperature  
and the ~~temperature~~ dew-point. So  
<sup>in this way by the aid of the table</sup> getting this last difference, we subtract it  
from the observed temperature <sup>(of the dry bulb)</sup> and  
thus get the dew-point. Then, other  
tables show what elastic pressure of  
vapor each dew-point temperature involves;  
and by comparing this vapor-pressure  
of the dew-point with the vapor-pressure  
belonging to saturation at the temperature  
of the air at the time, <sup>(if the dew-point were at that degree)</sup> we get the relative  
humidity as compared with saturation,  
which is desired.

(See Loomis on Meteorology for Tables.)

air, has  
temperature.  
al ways

in dry  
expansion.  
ometer  
the pres-  
& HygroscoPy.

00 weighs  
of air sat-  
84 grs.  
at 52° by 4.2 grs. of  
oot; at 77° 9.8 grs.

It will  
[Barmett]  
ells hyggrom-  
tempera-  
ill begin  
lly cooled.

re will be  
N. Mexico,

by cool-  
pometer.



1) Things desirable to be determined concerning the hygrometric state of the atmosphere:

Absolute amount of moisture;

Amount of moisture compared with amount which <sup>will</sup> saturate the air at the temperature observed;

This last is practically most important, and is called relative humidity, — or, conversely, dryness, meaning the same; the ~~question~~ question how dry is it, being equivalent to how damp is it; just as how high & how low both mean, what is the height compared with a fixed standard.

Items in this determination:

Difference between dry and wet bulb;

Dew-point; Difference between the temperature of the air and the dew-point;

Elastic force or pressure & weight of the vapor present.

The moisture

The

h

D

S

L

4



RELATION OF  
THE AIR'S  
HUMIDITY-TO-TEMPERATURE

The humidity of the air, has a constant relation to temperature. It is estimated in several ways (page 16)

LIGHTNESS  
OF MOIST  
AIR.

②

Moist air is lighter than dry air, on account of its expansion. This is indicated by the barometer which however shows better the pressure of winds.

Hygrometry & Hygroscopy.

WEIGHT  
OF A MOIST AIR  
AND OF VAPOR.

①

A cubic ft. of dry air, at 60° weighs 536.28 grs; of vapor, 577 grs; of air saturated with water, at 60° 532.84 grs., at 0°, 606 grs., 100°, 486.65.

Air is saturated at 52° by 4.4 grs. of ag. vap. to 1 cub. foot; at 77°, 9.8 grs.

The comparative weight will give the relative humidity.

DANIEL'S  
HYGROMETER.

③

The principle in Daniel's hygrometer, is the dew-point, or the temperature at which moisture will begin to condense, upon a body gradually cooled.

If the air is very dry, there will be no dew. There is none in N. Mexico, Egypt & Peru.

DEW-POINT.

The dew point is taken by cooling down the bulb of the thermometer. Dew is produced by it.



See attached pages just back

There are

2 kinds of

Barometer

Mercurial & aneroid.  
most exact;  
describes its principle.  
metal box  
& index.

Space of 1/2 page

Dr A. Hewson's paper on effect of atmospheric states  
on mortality of Surg. operations (Penny, Hosp. Rep. 1868)  
259 operations, 30 died -

Most deaths from shock, very dry air; most from  
fever & pyrexia, damp. Ascending barometer most  
favorable, if steady; next, stationary, - least so low  
and descending barometer, - i.e., diminution of pressure.  
Bert, in France, has recently made similar observations. [?]

Electrical relations probably have  
place here. Increased pressure of the air has  
been, in Europe, sometimes used remedially. In  
climbing high mountains, its diminution is felt. - Marine animals, -  
[space blank]



# Boston

VOLUME VII.

## Familiar Science.

### THE CHROMOSPHERE.

BY PROF. C. A. YOUNG.

THE Chromosphere, or "color-sphere," is the sheet of scarlet flame enveloping the more intensely luminous and still hotter photosphere which constitutes the visible surface of the sun.

The chromospheric flames, however, differ from terrestrial flames in this; that in them, so far as we can learn, nothing is being burned up. Like the electric spark and the voltaic arc in vacuo, they seem to consist merely of masses of intensely heated gas absolutely too hot to burn — at a temperature above what chemists call the "disso-

the atmospheric glare was so great that glimpses of the prominences might be obtained by this simple means, and the experiment was tried upon the Peak of Teneriffe in 1851, but without success.

Thus far the spectroscope alone furnishes the means of overcoming the difficulty.

The air-light, being simply reflected sunshine, is *white*, consisting of an infinite number of rays of as many different hues gradually shading into each other; and although this whole collection of different colored rays forms in its combination a brilliant light, yet the individual rays taken separately are not very powerful.

The light from the chromosphere, on the contrary, is composed of only a few different kinds of light, and although as a whole, much less brilliant than the aerial illumination, its separate components far surpass in power the corresponding rays of the air light.

Now the peculiar effect of the spectroscope is to separate the different-hued rays of light, and to spread them out into a spectrum. When we thus disperse the white light of the air, and so diminish the brightness of the background, the colored rays of the chromosphere become easily visible. This beautiful application of the spectroscope was independently invented by Janssen, one of the French observers of the eclipse of 1868, and by Lockyer, who was a few weeks later, simply because his instrument was not finished in season.

For observations of this nature the spectroscope, which should have the highest attainable dispersive power, is attached to a telescope in such a way that the image of the sun formed by the object glass may fall accurately upon the slit. It is then adjusted so as to bring the so called C line upon the cross-wires. On looking into the instrument one sees a broad red band reaching across the field of view. (In a powerful spectroscope of course only a small portion of the spectrum is visible at once, and when the red is in sight the other colors are out of the field.) This band is barred with many fine dark lines, of which C is by far the most conspicuous; now move the telescope a little until the slit becomes exactly tangent to the edge of the sun's image, and just as the rest of the spectrum fades away, the C line, before perfectly black, flashes out with an intense scarlet brilliance which almost invariably extorts an exclamation of surprise and delight from an unaccustomed observer.

Now widen the slit a little by its adjusting screw, and you see a portion of the chromosphere, with the beautiful cloud-forms that float above it, as when one looks out upon a sunset sky through half-opened blinds from across a darkened room.

In this way the chromosphere and prominences can be seen and studied, not perhaps quite

DRY  
AND WET BULBS.

MAY TO KEEP THE BULBS  
WET.

HAIR  
HYGROMETERS.

CURIOUS  
TOY.

Dry & Wet bulbs,  
the humidity of the  
in the shade, as  
ground. The wet  
with cold muslin  
cotton which dis-  
thus kept constant  
ence between the  
relative humidity; as evaporation

The cotton should  
rated with carb  
water should be

Human hair  
hygrometer. It is  
graduated. On  
which moves as  
contracts. It keeps  
or three months.

A curious toy  
with two doors is  
It is so contrived  
air is moist a

Electricity  
of atmosphere, no doubt  
influential.



A VAST amount of information is constantly being gathered and collated by the U. S. Signal Service, out of which is being gradually built up the true science of that class of meteorological phenomena. Among the general observations thus far noted, may be mentioned the following:—

This central line of minimum pressure is generally of a great length from north to south, and moves side foremost toward the east.

The velocity of this line is such that it travels from the Mississippi to the Connecticut River in about twenty-four hours, and from the Connecticut to St. John, Newfoundland, in nearly the same time, or about thirty-six miles an hour.

When the barometer falls suddenly in the western part of New England, it rises at the same time in the valley of the Mississippi, and also at St. John, Newfoundland.

In great storms the wind for several hundred miles on both sides of the line of minimum pressure blows toward that line directly or obliquely.

The force of the wind is in proportion to the suddenness and greatness of the depression of the barometer.

In all great and sudden depressions of the barometer there is much rain or snow; and in all sudden great rains or snows there is a great depression of the barometer near the centre of the storm, and rise beyond its borders.

Many storms are of great and unknown length from north to south, reaching beyond our observers on the Gulf of Mexico and on the northern lakes, while their east and west diameter is comparatively small. The storms therefore *move side foremost*.

Most storms commence in the "far west," beyond our most western observers, but some commence in the United States.

When a storm commences in the United States the line of minimum pressure does not come from the "far west," but commences with the storm, and travels with it toward the eastward.

There is generally a lull of wind at the line of minimum pressure, and sometimes a calm.

When this line of minimum pressure passes an observer toward the east, the wind generally soon changes to the west, and the barometer begins to rise.

There is generally but little wind near the line of maximum pressure, and on each side of that line the winds are irregular, but tend outward from that line.

The fluctuations of the barometer are generally greater in the northern and the eastern than in the southern and the western parts of the United States.

In the northern parts of the United States the wind generally in great storms sets in from the

north of east and terminates from the north of west;  
and in the southern parts the wind generally sets  
in from the south of east and terminates from the  
south of west.

During the passage of storms the wind generally changes from the eastward to the westward by the south, especially in the southern parts of the United States.

The northern part of the storm generally travels more rapidly toward the east than the southern part.

During the high barometer of the day preceeding the storm it is generally clear and mild in temperature, especially if very cold.

The temperature generally falls suddenly on the passage of the centre of great storms, so that sometimes, when a storm is in the middle of the United States, the lowest temperature of the month will be in the west on the same day that the highest temperature is in the east.

The first of the principles upon which the Signal Corps proceeds is that the invariable course of air currents is such as will equalize the atmospheric pressure upon the earth's surface, and that wherever inequalities exist, the winds are set in motion, the air thus finding its level, just as water or any other visible fluid does.

meter. Mercurial & aneroid.  
most exact;  
describe its principle. initial box  
& index.

[Space of 1/2 page]

on effect of atmospheric states  
is (Penny, Hoop, Repnt<sup>for 1868</sup>)  
very dry air; mast from  
ascending barometer most  
timory, — least so low  
— i.e., diminution of pressure.  
made similar observations. [?]  
relations probably have  
pressure of the air has  
is used remedially. In  
tion is felt. — Marine animals.  
[space blank]



~~average~~ ~~average~~

In England, the dew point is  $35^{\circ}$  in our Northern States  $16^{\circ}$  <sup>often as low as</sup>

DRY AND WET BULBS.

When Dry & Wet bulbs, are used to determine the humidity of the air, they are put in the shade, about 4 ft. from the ground. The wet bulb is covered with ~~coll~~ muslin and then with cotton which dips in water. It is thus kept constantly wet. The difference between the two will show the relative humidity; as evaporation cools the wet bulb if the air is not saturated.

WAY TO KEEP THE BULB WET.

The cotton should first be saturated with carbonate of soda. The water should be rain water or distilled water.

HAIR HYGROMETERS.

Electricity of atmosphere; no doubt influential.

Human hair has been used as a hygrometer. It is stretched out and graduated. On one end is a needle which moves as the hair expands or contracts. It keeps accurate for two or three months. (Saunders) Ropes!

CURIOUS TOY.

A curious toy consisting of a house with two doors is a good hygrometer. It is so contrived that when the air is moist a man comes out - gone

Chem. Hygrometer - Camphor Glass



7

[End of 23<sup>d</sup> Lecture, 1871]  
 [End of 17<sup>th</sup> Lecture, 1873]

End of 14<sup>th</sup> Lecture, 1870 — 70

End of 14<sup>th</sup> Lecture, 1868



23.  
This indicates the propriety of  
considerable addition of ~~moisture~~  
to the air of heated rooms.

Dr. Wetherill estimated that  
the Halls of Congress ought to have  
nearly 8 gallons of water ~~evaporated~~  
every hour for the proper hydration of their  
atmosphere. My impression is (although  
not definitely informed about it) that, by  
Wetherill's efforts, a good deal of pains & skill  
have been given towards providing arrangements  
for good air in the Capitol at Washington. It is  
probable that, instead of being (1876), as one repre-  
sentative expressed it, "murdered by scientific  
ventilation" the congressmen are suffering from  
very unscientific neglect of the proper use  
of the means that are provided.

At the Smithsonian Institution, steam is  
added to the air of the air chamber of the  
furnace by which the building is warmed.  
This was introduced there by Prof. Henry,  
who has <sup>long been</sup> at the head of the Institution.  
The principle thus illustrated is important  
in buildings of all kinds. Stove heat.

MAKING  
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DAMP D

KEEPING  
A W  
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★ (Wetherill, Franklin Inst. Journal, 1869)

★ Relative humidity of air varies from saturation, 100, to 12 or less.

Mean at Washington, 1856-69, 68.15.

Müller, at Halle, Germany, mean 75.

At Philada., in 12 years, 68.5 (Loomis says 70.) Roscoe found it most agreeable in the House of Lords in London, not below 55 nor above 82; mean between these extremes being 68.5. In Mammoth Cave, Ky., pleasant for exercise when, with temperature 58° Fabr., rel. hum. is 87.6. (Wetherill) A very good mean, no doubt, is 67.5.

Every expired breath adds about 17 grains of aqueous vapor to each cubic foot of exhaled air. (Each adult gives out in breath from 12 to 18 gr. water vapor each minute.)

But, by warming the air, its relative humidity is proportionately reduced. By raising the temperature from 50° to 70° Fabr., rel. hum. reduced from 100 to about 25,

[End of 23d Lecture, 1871]  
[End of 17th Lecture, 1873]



door, and when it is dry, a woman comes out of the other.

Two practical measures of adjustment are 1st Making a fire on a damp day. This is especially important in malarial regions and in basements; 2<sup>nd</sup> in Spring & Fall, often neglected.

2nd. Always keeping water on stoves and furnaces. Stove air is very uncomfortable if this precaution be not taken.

## OZONE.

Discovered

by Van Marum

1785

Schönbein

ITS DISCOVERY.

Ozone is the next constituent of the air. The whole subject of ozone is unsettled. There are facts concerning it, which can not be ignored, even if they do not explain it. Schönbein & Richardson discovered it in 1839 and published a work on it. He thinks it is oxygen in an active state, having intense affinities.

Schönbein ~~discovered~~ <sup>believed</sup> that there are three states of oxygen, 1st. ozone, 2nd antozone 3rd ordinary oxygen, union of the two others. Probably antozone is really peroxide of hydrogen.

Electricity produces ozone. Its sources in the atmosphere, are necessa-

MAKING  
ON A FIRE  
DAMP DAY.

KEEPING  
WATER ON  
THE STOVE.

OZONE  
ANTOZONE  
OXYGEN.

ELECTRICITY.



nat Sources of  
formation  
Winds -

Sea -

plants  
(~~Conifers~~)

Phosphorus  
fish water lakes

not man-made  
See Hygiene

How to make ozone.

Electrical sparks thro' oxygen gas -

Piece of phosphorus just under water

Glass rod, heated, in ether vapor -

Action of  $SO_3$  on peroxide of barium

Exposure of oil of turpentine to the air - &

Properties of ozone -

odor - & [space blues]

density - 1 1/2 to 4 times heavier than O  
(Rouss)

dropping of  
permanganate of  
potass. into  $SO_3$ .

May, 1873  
Montepiarre and  
odorous fumes



Somewhat  
as yet uncertain  
~~is~~, mere speculation. It is estimated that 10,000 (.0001) of the air is ozone.

Moffat thinks that phosphorescence has something to do with it. ~~of the sea~~

Some say, the Equatorial <sup>wind</sup> currents carry ozone. ~~OR, friction of waves of the sea, & of plants~~

Some say that it will prevent cholera. ~~It is 2/3 or less of volume~~  
Ozone smells (etymol.) ~~3 vols cond. to 2.~~ <sup>It destroys india rubber, & oxidizes metals, even silver.</sup>

Its effect on dead organic matter is to stop decomposition.

It is a purifier, and is of immense importance in the <sup>natural disinfection</sup> purification of large cities. Is consumed in foul places.

When concentrated it is irritating to the <sup>respiratory</sup> mucous membrane, and may even ~~cause death~~. It requires a temperature above 60° and below 75° <sup>show its properties</sup>.

Carnivora are most easily affected by it; ~~tats more than rabbits.~~

Influenza has been associated with ozone. The ~~reasons~~ for this are that ozone is irritating to the breathing apparatus, and that an excess of ozone has been noticed <sup>sometimes</sup> when ~~an~~ influenza has ~~been~~ <sup>occurred</sup>.

PHOSPHORESCENCE.

EQUATORIAL CURRENTS.

CHOLERA.

IT STOPS DECOMPOSITION.

IT PURIFIES.

IRRITATING WHEN CONCENTRATED.

CARNIVORA

INFLUENZA.

REASONS FOR THE ASSOCIATION.



Test for ozone made uncertain by the same reaction  
occurring with ~~ozone~~ (see my loose notes).

~~X~~ Nitrous acid, oil of cloves, etc —



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MAN



Test

Meissner has shown that when oxygen is ozonized by electr. & led through iodid. potass. — ev. trace of ozone is removed — if the gas so emerging be passed thro pure water — a thick white mist appears on its surface — which can be poured like  $\text{CO}_2$  —

"Atmosone;" — Meissner thinks identical with autozone. Gradually disappears in atm experiment.



COLDS.

CROUP.

BRONCHITIS.

PNEUMONIA.

APPROPLEX.

EPILEPSY

Colds  
ed by the  
Dr. Moffatt  
chitas as  
Eighty  
from a  
occurred  
excessive.

Latif (Grand Acad.) Frém. said of one  
certain test for ozone - oxidation of silver  
by passing current of moist air over it -  
The test paper is affected by nitrogen, ox-  
idized water, ammonia, formic acid,  
essential oils, acid products of combustion,  
dusts.

ANTOZONE.

PROMOTES  
PUTRIFICATION

TESTS  
FOR OZONE.

STARCH  
& IODIDE OF POTASSIUM.

or iod. potass  
papers without starch  
the iodine red  
being brought out.

or iod. pot. &  
redend litmus paper

SULPHATE  
OF MANGANESE.

Schönbein  
Antozone was discovered by  
Richardson. He inhaled air &  
had the  $CO_2$  taken out, and inhaled  
it again and again until he found  
that the oxygen lost its vital power.  
Antozone promotes putrefaction.  
The test for ozone is its action on  
starch and iodide of potassium.  
We use 200 pts. distilled  $H_2O$ , 10 of starch  
and 1 of iodide of potassium. The  
ozone sets the iodine free and  
colors the starch blue. <sup>of nos & some vol.</sup>  
<sup>veg. oils the same</sup>  
There are other tests. Boudin's  
consists in the action of ozone on  
sulphate of manganese, giving a  
brown precipitate. However, - wine-colored  
litmus papers, if impregnated with iod. potass. ozone makes  
them blue by forming alk. potassa.



Test for ozone — Schindler — 1

~~from pure iod. potass. <sup>soln.</sup>~~  
~~stand — <sup>no</sup> phosphates.~~

9.10  
 strips of paper soaked first in distilled  
 water — then in the above solution — &  
 dried slowly in cool dark place in  
 horizontal position. [Boudin gives a test  
 Paper saturated with soln. of sulphate or chloride of <sup>anhydrous</sup> ~~anhydrous~~  
 which he says becomes brown in ozone.]

Meissner has shown that when oxygen  
 is ozonized by electr. & led through  
 iodid. potass. — every trace of ozone is  
 removed — if the gas so emerging be passed  
 thro pure water — a thick white  
 mist appears on its surface — which  
 can be poured like CO2 —

"Atmoszone;" — Meissner thinks identical with  
 antiozone. Gradually disappears in atm.  
 experiments.



COLDS.

CROUP.

BRONCHITIS.

PNEUMONIA.

APPOPLEXY.

EPILEPSY

<sup>imagined by some to be</sup>  
Colds are caused by ozone, generated by the friction of currents of air. Dr. Moffatt thinks it causes croup, bronchitis and pneumonia.

Eighty per cent of the deaths from apoplexy and epilepsy, have been said to have occurred on days when ozone was excessive.

ANTOZONE.

Antozone was discovered by Richardson. He inhaled air & had the  $CO_2$  taken out, and inhaled it again and again until he found that the oxygen lost its vital power.

PROMOTES PUTRIFICATION

Antozone promotes putrefaction.

TESTS FOR OZONE.

The test for ozone is its action on starch and iodide of potassium.

STARCH OF POTASSIUM IODIDE

or iod. potass papers without starch, the iodine red being brought out.

We use 200 pts. distilled  $H_2O$ , 10 of starch and 1 of iodide of potassium. The ozone sets the iodine free and colors the starch blue.

or iod. pot. & red & litmus paper

SULPHATE OF MANGANESE.

There are other tests. Boudin's consists in the action of ozone on sulphate of manganese, giving a brown precipitate.

Howe's test - wine-colored liquid, 1/2 oz. impregnated with iod. potass. ozone makes that liquid dark blue by forming alk. iodide.



Burdell, a French Savant, in some elaborate investigations did not find absence of ozone to correspond with fever-malaria (Parkes) ~~happening~~.

Difficulties in Mark's observation of it.



When ozonized oxygen is passed through iodide of potassium, all the ozone is lost.

OZONE  
OVER LAKES.

Clemens found ozone given off abundantly, just over lakes. Over marsh water the oxygen is not ozonized; over good water, it is.

SUPPOSED  
EFFECT  
ON  
MALARIAL FEVERS.

Dr. Hammond observed that in two encampments, one on a river and the other, half a mile from it, that the former had <sup>malarial</sup> fevers and the latter had not. It was found that in the former place, there was a deficiency of ozone, and in the latter, there was an excess.

CHOLERA.

The same statement has been made in regard to cholera, but it has been contradicted, after careful experiments.

~~Clemens ascribes ozone to currents of air over water.~~

DISCREPANCIES

Mitchell <sup>in Algeria</sup> found many discrepancies in the statements concerning ozone. Its disinfectant value is strongly asserted by some.

NON-ESSENTIAL  
CONSTITUENTS.

The <sup>really</sup> non-essential constituents of air



Sent  
copy

For Black Board

3<sup>d</sup> (1872) Lecture.Germ Theory of Disease.

1. It is proved that the air contains a multitude of minute animal and vegetable organic forms; aerophytes, aerozoa, spores and germs; especially, where the air is impure.
2. It is known, also, that (besides entozoa and epizoa <sup>animal</sup> parasites) microscopic vegetations grow upon the skin in favus, mentagra, &c, and in the throat in thrush; perhaps in diphtheria.
3. It is asserted by Pasteur and others that fermentation and putrefaction depend upon the presence of minute organisms, mostly derived from the air.
4. It is inferred, that many diseases, as fevers, cholera, influenza, diphtheria, <sup>may be</sup> ~~are~~ in like manner produced by organic air-germs; and that <sup>the suppuration of</sup> pyæmia, ~~putrefaction~~ and hospital gangrene are so caused.
5. These conclusions, however, are not yet demonstrated. It is probable that many aerial organisms consume septic matter so as to purify the air; while some of them, only, are <sup>vehicles of</sup> ~~causes~~ of disease, especially where they multiply out of proportion to the material on which they live, & when the bodies of those whom they touch are feeble.



come next.

# IODINE.

1. Iodine is found in small quantities especially at the sea shore. It is absorbed <sup>when we breathe</sup> to the extent of  $\frac{1}{5}$ . It <sup>must then</sup> acts on the system, hence <sup>perhaps</sup> its ~~presence~~ <sup>advantage</sup> in cases of scrofula.

# NITRIC ACID

2. Nitric acid is found in very small amounts. It is <sup>abundant</sup> most, after a thunder storm. Hence the souring of milk attributed to thunder.

# AMMONIUM.

3. Ammonia is another constituent. There is more at night, and more in crowded rooms (1 part in 100 million average).

It has been incorrectly denied that ammonia is exhaled from the lungs.

# NITROUS ACID.

4. Nitrous acid. Hyponitric N<sub>2</sub>O<sub>4</sub>

# SULPHURIC & SULPHUROUS ACIDS.

5 & 6. Sulphuric & sulphurous acids are particularly <sup>present</sup> in large towns where coal is burned. Sulphur is present in every house as is shown by the tarnishing of silver.

# SULPHURETTED HYDROGEN.

7. Sulphuretted hydrogen arises from decay of organic matter. Privies give it off, as do marshes,

Truett found (1873)  
 most ammonia  
 at considerable elevation.



End of 2<sup>nd</sup> Lecture, 1872

Seen burning with blue flame on the top of a coal fire;  
formed below, in the middle of the coal, from imperfect combustion.  
Observations on injurious effects of Cast

iron stoves: probably from CO escaping through.  
Thom first noticed this.  
Dr. Derby of Boston, a treatise on the subject.

Experiments carefully made show that but little  
can leak through solid cast iron.

Space of 8 lines



and certain volcanoes and mineral springs, & grave yards.

As a gas, it is very unwholesome.  
 $\frac{1}{800}$  <sup>in the air</sup> of a part will kill a small animal.  
 $\frac{2}{250}$  will kill a horse | <sup>2 Paris sewers, workmen hear</sup> 24 to 90 parts in 1000.

It is detected by its blackening lead. Hence Lead salts are its best destroyers.

It does not produce malarial fevers. Daniell in Africa thought it did.

CARBURETTED HYDROGEN.

8. Carburetted hydrogen is of two kinds; heavy & light. The latter is the explosive fire-damp of mines. It is not a positive poison. Davy.

CARBONIC ACID.

9. Carbonic oxide comes from fires and burning-gas. It is poisonous.

CARBONIC OXIDE.

10. Carbonic acid is not as bad as carbonic oxide.

PHOSPHURETTED HYDROGEN.

10. Phosphuretted hydrogen is rarely met with. These are all the gases & fumes in the earth.

ORGANIC MATTER.

There are also definite organic matters. Some of these are gaseous and some has odor, and some is solid.



End of 15th Lecture 1867

End of 14th — 1869 —

# a member of the class of 1867 told me of a patient  
 in the Charity Hospital of this city who, having been for  
 18 years engaged in an establishment for making skins  
 of black paint, — although he had left it 12  
 years, expectorated a good deal of black material,  
 as explained. "Collier's lung."

\* "aeroxoa - aerophyta -"

Chloro